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AUTOMATIC VACUUM WEIGHING APPARATUS FOR INVESTIGATING THE DECOMPOSITION KINETICS OF SOLIDS

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ABSTRACT

The article describes the construction of an apparatus with automatic recording of the variation in weight of a substance; it consists of a quartz spring balance, a projecting device to present a magnified image of the lower end of the balance coil, and a photoelectric device to record the displacement of the lower end of the coil. A photosensor (FS-K1) is connected in one arm of an electronic amplifier bridge. When the intensity falling on the photosensor is diminished due to unbalance of the bridge, a reversing servo motor moves the photosensor out of the shadow zone. The stylus of the automatic recording device traces out the motion of the photosensor. The weight range is from 1 to 20 mg, with an error of $1 \cdot 10^{-6}$ g in recording a 30% weight loss. The accuracy with which weight is recorded may be altered by means of an objective with a variable focal length.

In the investigation of thermal decomposition processes in solids, automatic recording of the change in weight is normally employed in conjunction with an equal arm balance. A significant drawback of such equipments is the difficulty with which vacuum is created in the reaction vessel, along with low sensitivity.

It is a fairly simple matter to evacuate the reaction vessel in the case /1122

*Numbers in the margin indicate pagination in the original foreign text.

of a spring balance, but the automatic recording of the weight changes becomes more complicated. For example, the automatic vacuum weighing apparatus described in reference 1, which is based on an induction data unit, is capable of achieving high sensitivity on the part of the spring balance and good evacuation of the reaction vessel, but the induction unit itself is situated directly in the reaction vessel, thus limiting the potential capabilities of the method; moreover, a complex electronic instrumentation is required for automatic recording of the weight changes.

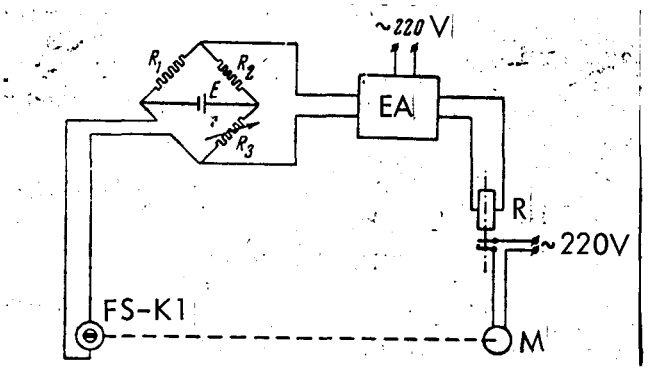

Figure. Block Diagram of the System for Automatic Recording of Weight Changes: FS-K1 - Photosensor; R_1, R_2, R_3 - Bridge Arms: E - Bridge Power Supply; EA - Electronic Amplifier; Re - Relay; M - Servo Motor.

The system that we propose consists of a quartz helix, a molybdenum glass reaction vessel, oven, projection lamp, and subsystem for the automatic recording of variations in weight of the material (see the figure).

This device stands out from its predecessors in the fact that the sensor (data unit) is set apart from the reaction vessel at some distance from it.

The automatic part of the system comprises a photoelectric unit (FS-K1), bridge, electronic amplifier, reversing servo motor, and a tape-feed mechanism (from an EPP-09 recording instrument).

The variation in weight is recorded in the following manner.

With a change in weight of a substance, a displacement is experienced by the lower end of the helix coil, which is projected by means of the lamp onto the guides along which the photosensor is able to move. When the shadow moves so that it falls on the photosensor, an unbalance signal appears (the photosensor bridge is previously balanced at a given illumination). The signal is amplified by the amplifier and is delivered to the servo motor, which moves the photosensor out of the shadow zone. In this way, the photosensor continuously follows the projection of the end of the coil. The sensor, in turn, is connected to the stylus of an electronic tape mechanism, so that the variation in weight with time is recorded on tape.

Because the sensor is physically separate from the reaction vessel, the proposed apparatus may be used to study high-temperature processes, wherein this exerts no influence on the sensitivity of the balance (the sensitivity of the balance used in our apparatus is as high as $1 \cdot 10^{-6}$ g).

The apparatus permits one to investigate the decomposition kinetics of single crystals weighing 0.5 mg or more.

Furthermore, the projection lamp has an objective with a variable focal length, enabling one to change the sensitivity of the apparatus during an experiment.

The apparatus is assembled from standard components and sub systems and requires no special-purpose electronic instrumentation.

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